

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Monday 9 June 2025 – Morning

GCSE (9–1) Biology B (Twenty First Century Science)

J257/02 Depth in Biology (Foundation Tier)

**Time allowed: 1 hour 45 minutes
plus your additional time allowance**

YOU MUST HAVE:

a ruler (cm/mm)

Loose Sheet for Question 7 (with this document)

YOU CAN USE:

a scientific or graphical calculator

an HB pencil

Please write clearly in black ink.

Centre number

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Candidate number

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First name(s) _____

Last name _____

READ INSTRUCTIONS OVERLEAF



INSTRUCTIONS

Use black ink. You can use an HB pencil, but only for graphs and diagrams.

Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.

Answer ALL the questions.

Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

The total mark for this paper is 90.

The marks for each question are shown in brackets [].

Quality of extended response will be assessed in questions marked with an asterisk (*).

ADVICE

Read each question carefully before you start your answer.

1

(a) Which system transports oxygen and dissolved food molecules around the human body in the blood?

Tick (✓) ONE box. [1]

Circulatory system

☐

Digestive system

☐

Excretory system

☐

Gaseous exchange system

☐

(b) Which organ pumps blood around the human body?

Tick (✓) ONE box. [1]

Brain

☐

Eye

☐

Heart

☐

Kidney

☐

(c) Which type of blood vessel has valves to stop blood flowing backwards?

Tick (✓) ONE box. [1]

Artery

☐

Capillary

☐

Neuron

☐

Vein

☐

(d) Draw lines to connect each PART of the blood with its correct FUNCTION. [3]

PART

FUNCTION

Plasma

Destroy pathogens

Platelets

Help seal wounds

Red
blood cells

Transport dissolved
food molecules

White
blood cells

Transport oxygen

2

(a) Put these three structures in order of size, from the LARGEST to the SMALLEST. [2]

Chromosome

Gene

Nucleotide

Largest

Smallest

(b) Which statement describes the genome?

Tick (✓) ONE box. [1]

A section of DNA that stores the instructions to make a protein.

☐

All the physical features of an organism.

☐

The combination of alleles that an organism has.

☐

The entire genetic material of an organism.

☐

(c) Draw lines to connect each **DESCRIPTION** with the correct **NUMBER**. [3]

DESCRIPTION

NUMBER

The number of bases in each nucleotide.

1

2

The number of different nucleotides found in DNA.

3

The number of nucleotide strands in a DNA molecule.

4

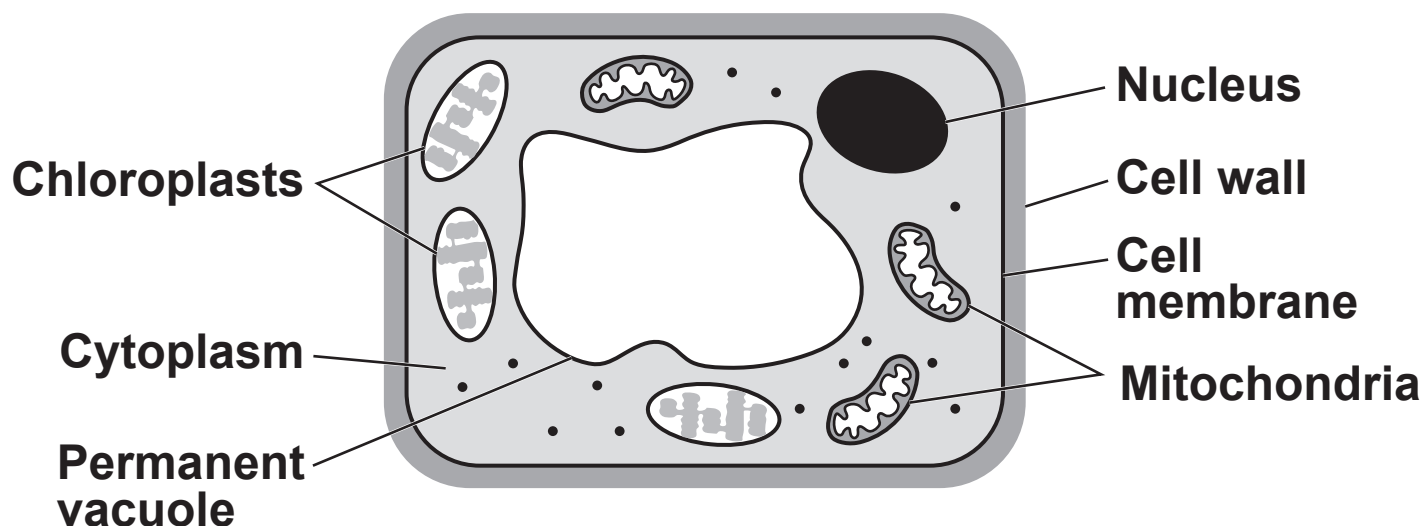
5

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3 Organisms can be classified based on their sub-cellular structures.

(a) FIG. 3.1 is a diagram of a cell showing its sub-cellular structures.

FIG. 3.1



(i) Classify the organism that the cell in FIG. 3.1 has come from.

Tick (✓) ONE box. [1]

Animal

☐

Bacterium

☐

Plant

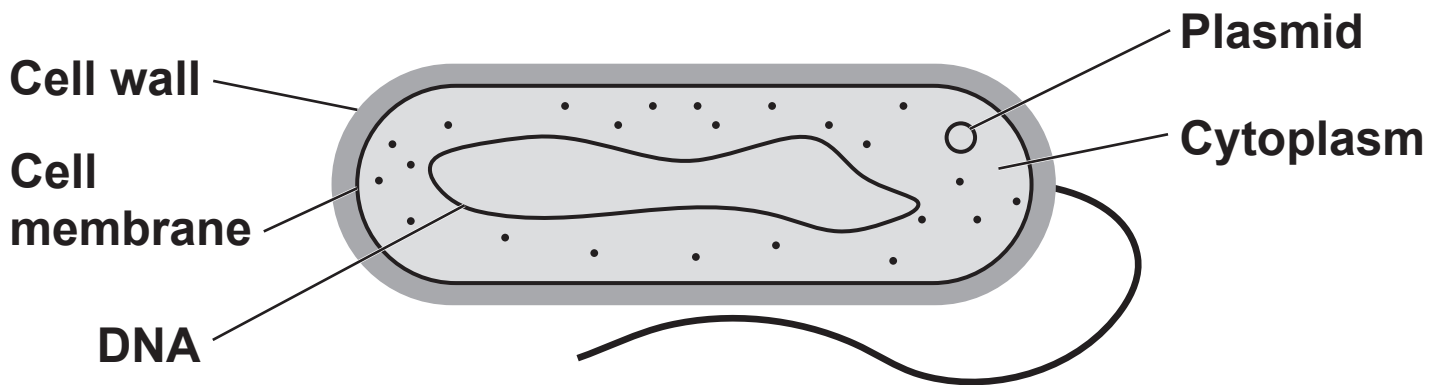
☐

(ii) State ONE piece of evidence present in the NUCLEUS of the cell in FIG. 3.1 that scientists could use to help classify the organism.

_____ **[1]**

(b) FIG. 3.2 is a diagram of a different cell.

FIG. 3.2



State TWO reasons why the cell in FIG. 3.2 would be classified as prokaryotic and NOT as eukaryotic.

1 _____

2 _____

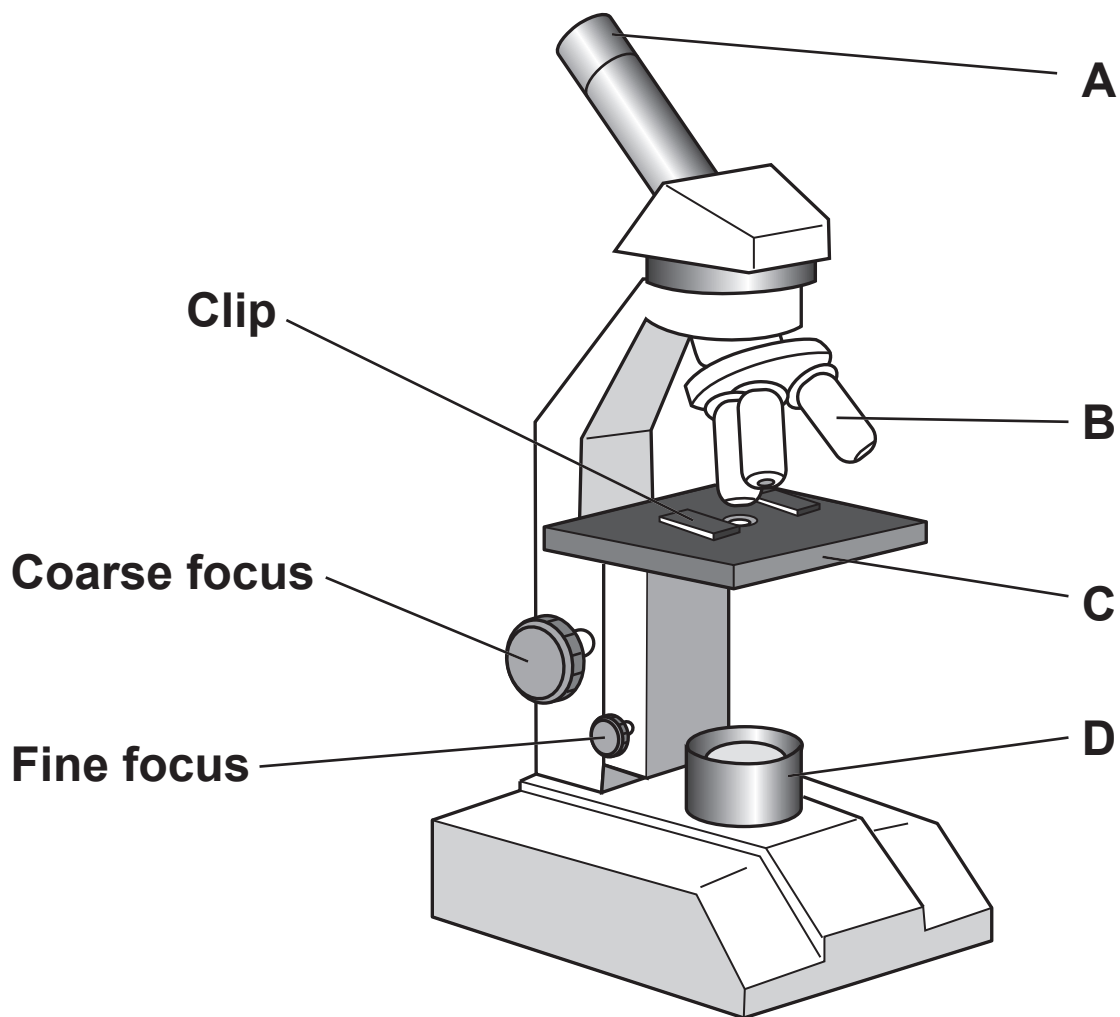
[2]

4 Plant leaves have tiny holes called stomata on their surfaces.

A student uses a light microscope to observe stomata on the underside of a small rectangular piece of a leaf.

(a) FIG. 4.1 shows a light microscope.

FIG. 4.1



Write the correct letter, A, B, C or D, next to each part.
[2]

Eyepiece lens _____

Light _____

Objective lens _____

Stage _____

- (b) Complete the method to describe how to set up the light microscope to observe stomata on a slide.**

Use words from the list.

eyepiece
light
objective
slide
stage

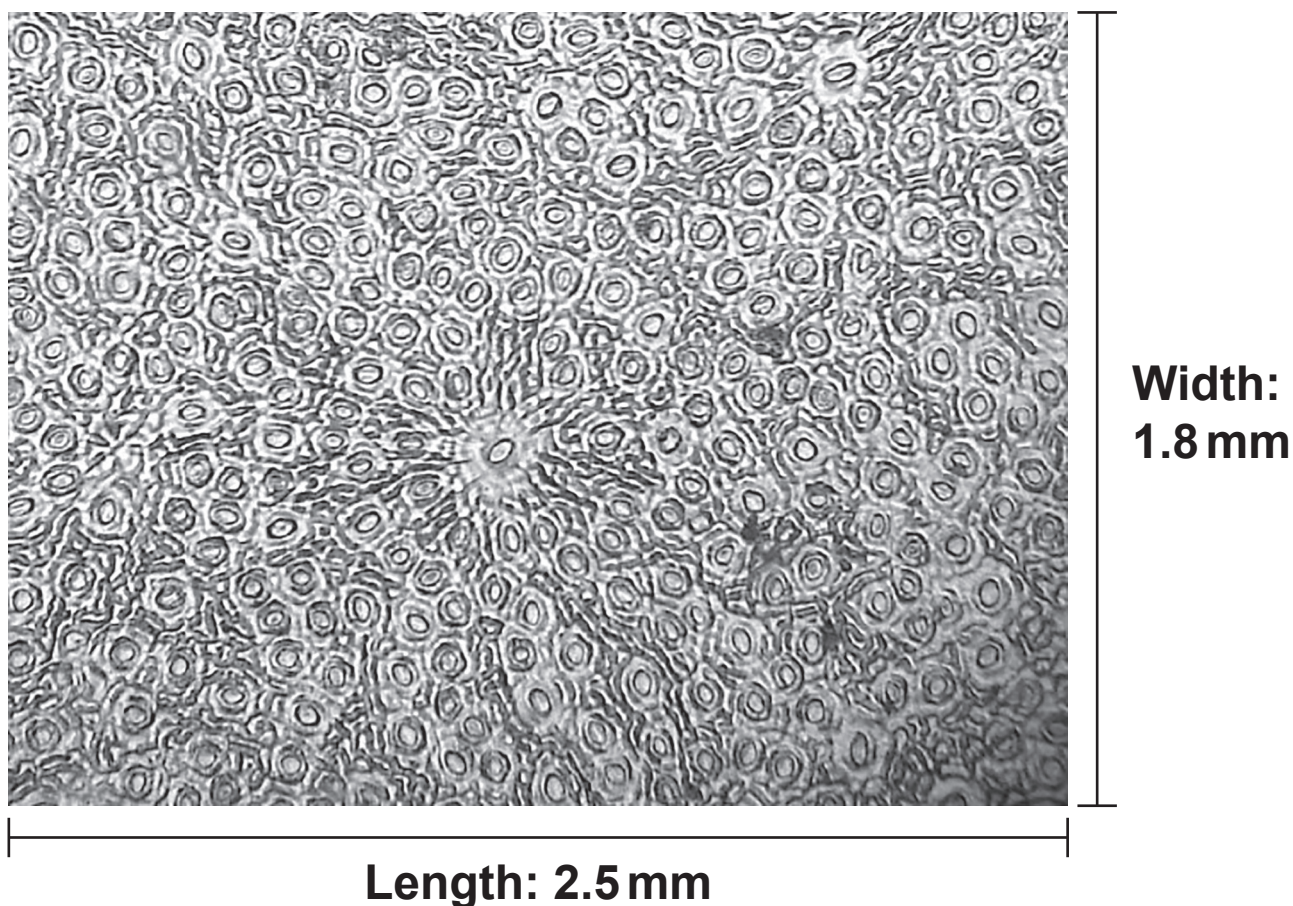
- 1. Place the _____ under the clips.**
- 2. Looking from the side, turn the coarse focus to move the stage towards the _____ lens.**
- 3. Looking into the _____ lens, use the coarse and fine focus to adjust the image until it is clear. [3]**

- (c) Why is it important to look from the side in step 2 of the method?

_____ [1]

- (d) FIG. 4.2 shows what the student observes.

FIG. 4.2



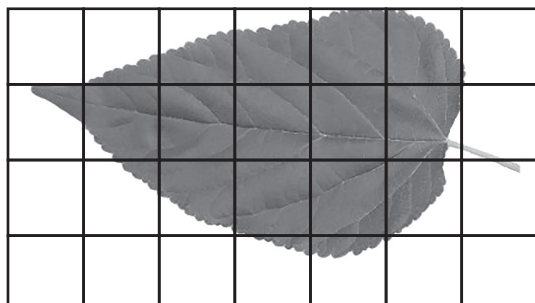
- (i) Calculate the area of the piece of leaf shown in FIG. 4.2.

Area = _____ mm² [2]

(ii) FIG. 4.3 shows the underside of the leaf on a grid.

Each square of the grid measures $1\text{ cm} \times 1\text{ cm}$.

FIG. 4.3



ESTIMATE the surface area of the underside of the leaf.

Use FIG. 4.3.

Include every square that is half-filled or more than half-filled with leaf.

Estimated area = _____ cm^2 [1]

(iii) Describe how the student can produce an **ESTIMATE** of the total number of stomata on the underside of the leaf without counting all of them.

[2]

- (iv) Explain ONE benefit of producing an estimate of the total number of stomata on a leaf rather than counting all of them.

[1]

- (e) The student produces estimates of the total number of stomata present on the top side and underside of five leaves from the same plant.

The table shows their results.

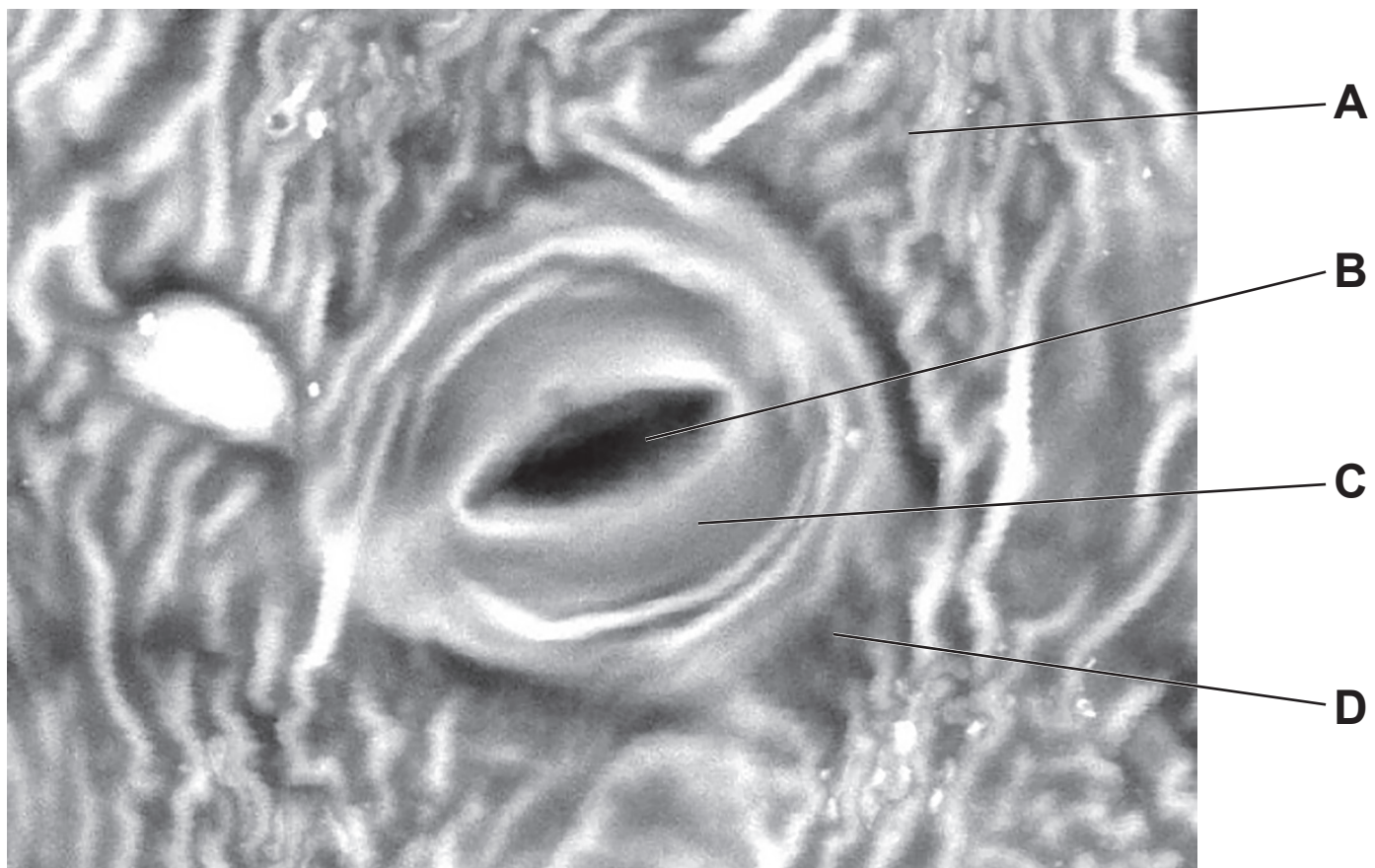
Leaf	Number of stomata on top side	Number of stomata on underside
1	150 000	750 000
2	125 000	625 000
3	170 000	850 000
4	160 000	800 000
5	142 000	710 000

Write ONE conclusion about the distribution of stomata on leaves shown by the data in the table.

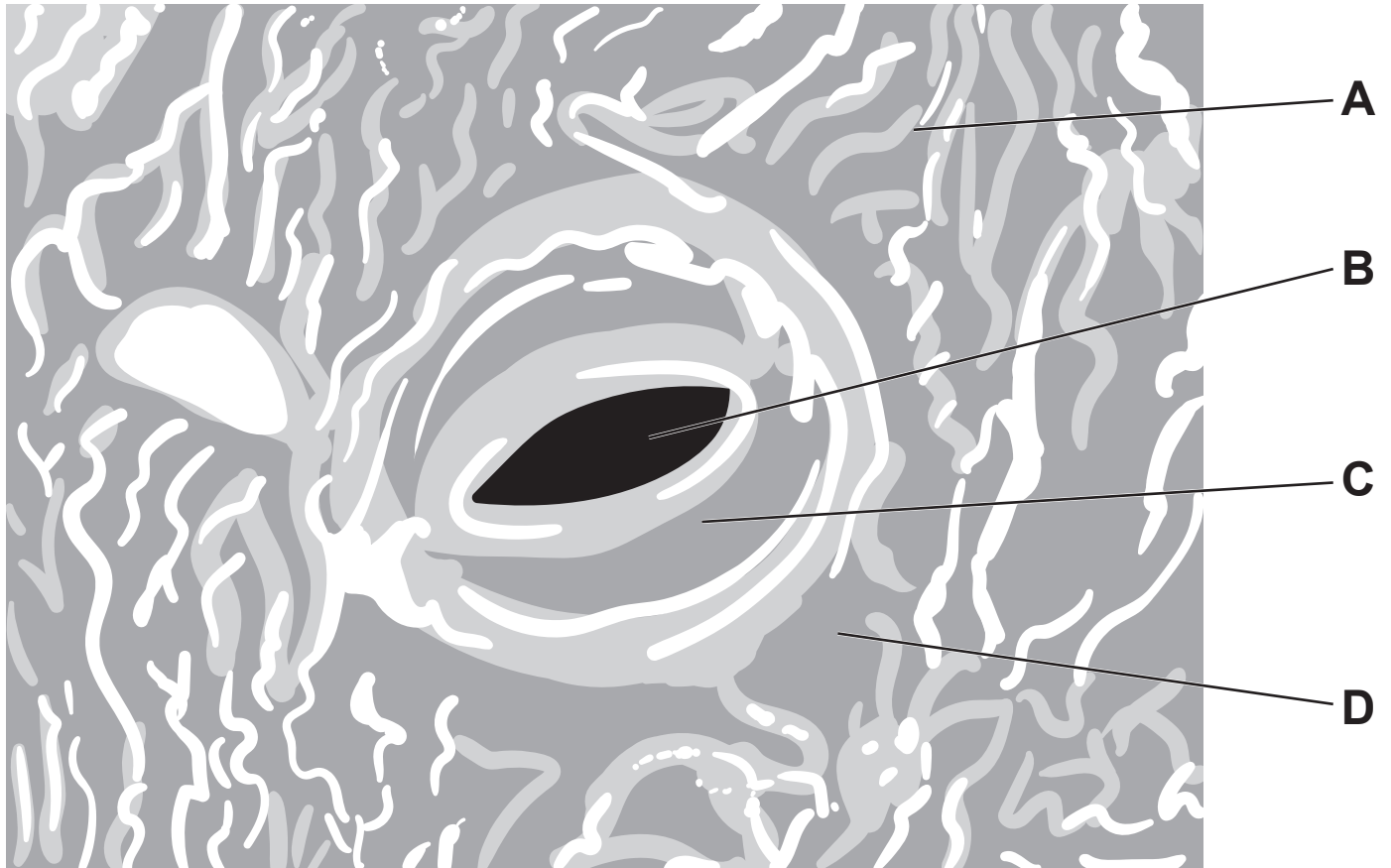
[1]

- (f) FIG. 4.4 shows one of the stomata observed with a more powerful microscope.

FIG. 4.4



Copy of FIG. 4.4



Which part is a guard cell?

Tick (✓) ONE box. [1]

A

☐

B

☐

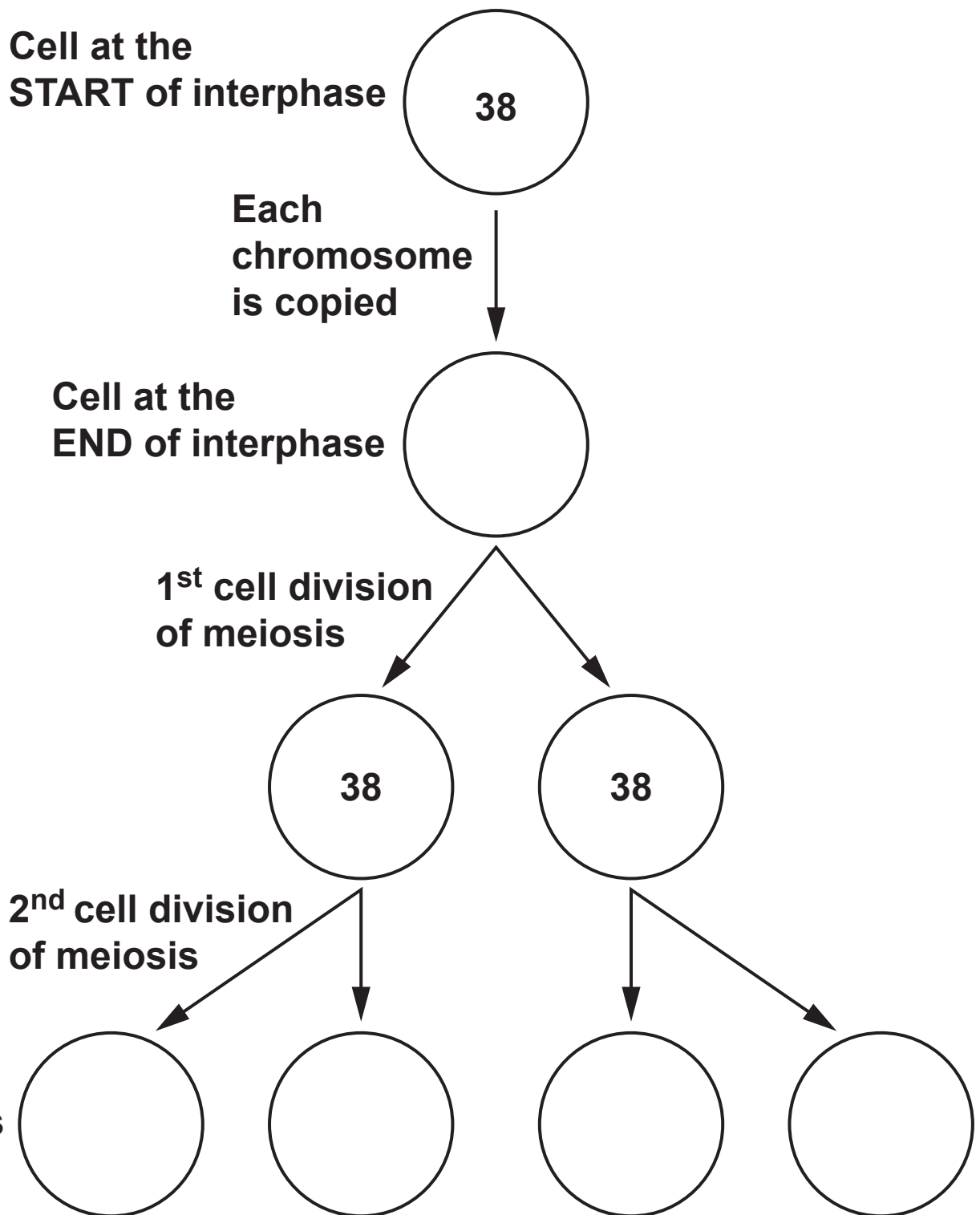
C

☐

D

☐

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5 Each body cell in a cat has 38 chromosomes.

(a) Cats reproduce sexually.

The gametes are made by meiosis, starting with one of the cat's cells.

COMPLETE the diagram opposite to show the number of chromosomes found in each cell during the stages of meiosis. [2]

(b) How many chromosomes will be present in a cat's zygote after fertilisation?

**Number of
chromosomes
in cat's zygote = _____ chromosomes [1]**

- (c) Adult body cells divide to make more body cells as part of the cell cycle.

Statements A to E are steps in this process. The statements are NOT in the correct order.

A The cell divides.

B The cell grows larger.

C The chromosomes are copied.

D The chromosome copies separate.

E The nucleus divides.

- (i) Write ONE letter in each box to show the correct order of the steps.

One of the steps has been done for you. [3]

	C			
--	---	--	--	--

- (ii) The cell cycle is divided into two parts called interphase and mitosis.

Tick (✓) TWO boxes to show the steps that take place during INTERPHASE. [1]

	INTERPHASE
The cell divides.	
The cell grows larger.	
The chromosomes are copied.	
The chromosome copies separate.	
The nucleus divides.	

- (d) Complete the sentence about MITOSIS.

Use a word from the list.

different
fertilised
gametes
identical

The cells produced by mitosis are genetically

_____. [1]

(e) Describe how cancer can sometimes result from mitosis.

[2]

6 Ash trees are common in the UK.

(a) What is the role of an ash tree in a food chain?

Tick (✓) ONE box. [1]

Herbivore

☐

Primary consumer

☐

Predator

☐

Producer

☐

(b) Describe TWO ways animals can be affected if an ash tree is removed from the ecosystem it was growing in.

1 _____

2 _____

[2]

(c) Many of the UK's ash trees are being killed by a disease called ash dieback.

Ash dieback is caused by a pathogen that can spread from tree to tree.

(i) Tick (✓) ONE box in each table to identify the pathogen that causes ash dieback and how it spreads between plants. [2]

	Bacterium	Fungus	Protist	Virus
Pathogen that causes ash dieback				

	By insects	Contaminated soil	During pollination	Spores carried by the wind
How it spreads between plants				

(ii) Which TWO of these are used by plants as a defence against pathogens?

Tick (✓) TWO boxes. [2]

Antibodies

☐

Antimicrobial substances

☐

Phloem

☐

Waxy leaf cuticle

☐

Xylem

☐

(iii) A few ash trees are resistant and do NOT die when infected with ash dieback.

Complete the sentences to explain why resistant trees will gradually become more common.

Use words from the list.

**adaptation
competition
mutation
natural selection
reproduction
variation**

Resistant trees have a genetic variant created by

_____ .

These trees are more likely to make offspring by

_____ .

**The offspring could inherit the genetic variant
for resistance.**

This is the process of _____ . [3]

(iv)*Scientists predict that ash dieback is likely to kill up to 80% of our 3 billion ash trees and cost the UK approximately £15 billion.

Scientists have discovered a species of fungus that releases a chemical that is toxic to the ash dieback pathogen.

Explain possible benefits AND risks of releasing this fungus with its toxin into woodland in the UK.

[6]

7

(a) FIG. 7.1 on the Loose Sheet shows the percentage of women and men in the UK who were classed as severely obese each year from 2000 to 2019.

(i) What percentage of WOMEN were classed as severely obese in 2002?

Percentage = _____ % [1]

(ii) Which THREE statements about the data in FIG. 7.1 are TRUE?

Tick (✓) THREE boxes. [3]

2000 to 2002 was the only time period where the percentage of men classed as severely obese stayed the same.

☐

2019 was the year with the highest percentage of severely obese men.

☐

Every year, a higher percentage of women than men were severely obese.

☐

The overall change in percentage of people classed as severely obese between 2000 and 2019 was bigger for women than men.

☐

The percentage of women classed as severely obese increased every year.

☐

The overall trend is an increase in severe obesity levels for both women and men.

☐

- (iii) The percentages of women and men with **CARDIOVASCULAR DISEASE** also increased from 2000 to 2019.

Suggest how the data in FIG. 7.1 could be linked to the increase in cardiovascular disease.

[2]

- (b) Measurements of a person's body can be used to draw conclusions about their health.

- (i) An adult has a mass of 81 kg and a height of 1.80 m

Calculate the body mass index (BMI) of the adult.

Use the equation: $BMI = \frac{\text{body mass}}{\text{height}^2}$, where body mass is in kg and height is in m.

BMI = _____ kg/m² [2]

(ii) TABLE 7.2 shows how BMI values can be categorised.

TABLE 7.2

BMI (kg/m ²)	< 18.5	18.5 – 24.9	25.0 – 29.9	30.0 – 34.9	> 34.9
Category	Underweight	Ideal	Overweight	Obese	Severely obese

Which category is an adult with a BMI of 23.0 kg/m² in?

_____ [1]

(iii) Some doctors think that a person's BMI alone can be misleading. They recommend that a person's waist-to-height ratio should also be considered.

Zayn has a waist circumference of 81 cm and a height of 179 cm.

Calculate the waist-to-height ratio for Zayn.

Use the equation: waist-to-height ratio

$$= \frac{\text{waist circumference (cm)}}{\text{height (cm)}}$$

Give your answer to 2 decimal places.

Waist-to-height ratio = _____ [2]

(iv) **TABLE 7.3** shows how waist-to-height ratios can be categorised.

TABLE 7.3

Waist-to-height ratio	< 0.40	0.40 – 0.49	0.50 – 0.53	> 0.53
Category	Underweight	Ideal	Overweight	Obese

**Amaya does very little exercise.
She has a BMI of 31.6 kg/m² and her waist-to-height ratio is 0.56.**

**Explain:
why Amaya is at high risk of developing type 2 diabetes
how she can reduce her risk.**

Use TABLE 7.2 and TABLE 7.3 to help you.

[3]

(v) Alex is thinking about his health. Here are some notes about Alex.

Waist-to-height ratio: 0.43

**Body type: Very muscular.
Low levels of body fat.**

**Exercise: Running daily.
Regular muscle-building at the gym.**

Alex finds out that his BMI is classed as obese.

He thinks he should lose weight to lower his risk of disease.

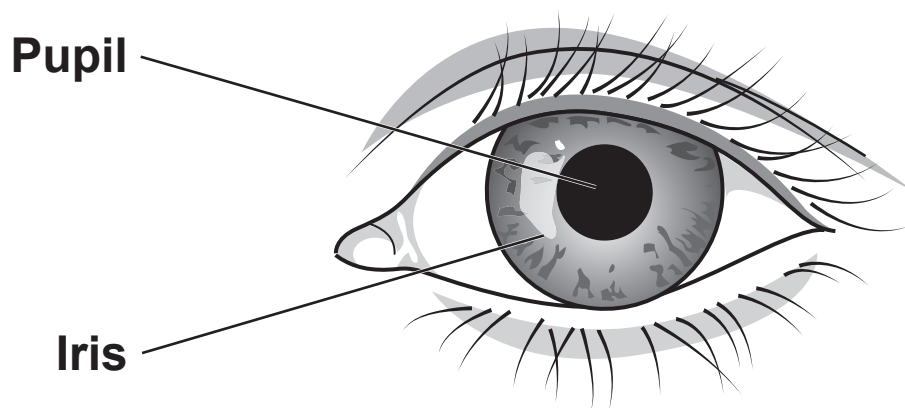
Explain why Alex is NOT correct.

Use TABLE 7.3 and the notes on Alex to help you.

[2]

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8 The pupil is part of the human eye.



A student investigates the effect of changing the light level on pupil diameter.

The student uses a lamp with adjustable brightness, measured in lumens.

The maximum brightness of the lamp is 1200 lumens (100%).

TABLE 8.1 shows the data the student records.

TABLE 8.1

Light level (%)	Light brightness (lumens)	Distance between lamp and eye (m)	Pupil diameter (mm)
80		1.5	4
40	480	1.5	6
20	240	1.5	8

- (a) Complete TABLE 8.2 to identify the variables in the investigation.

Put ONE tick (✓) in each row to show whether the variable is the **DEPENDENT VARIABLE**, the **INDEPENDENT VARIABLE** or **NEITHER**. [2]

TABLE 8.2

	Dependent variable	Independent variable	Neither
Distance between lamp and eye (m)			
Light brightness (lumens)			
Pupil diameter (mm)			

- (b) Suggest ONE other variable NOT included in TABLE 8.2 that should be controlled.

_____ [1]

- (c) Calculate the number of lumens equivalent to a light level of 80%.

Use the data in TABLE 8.1.

Number of lumens
equivalent to a light level of 80% = _____ lumens [2]

- (d) The student measures the pupil diameter by holding a ruler against the person's eye.

Suggest a safer way to measure the pupil diameter.

_____ [1]

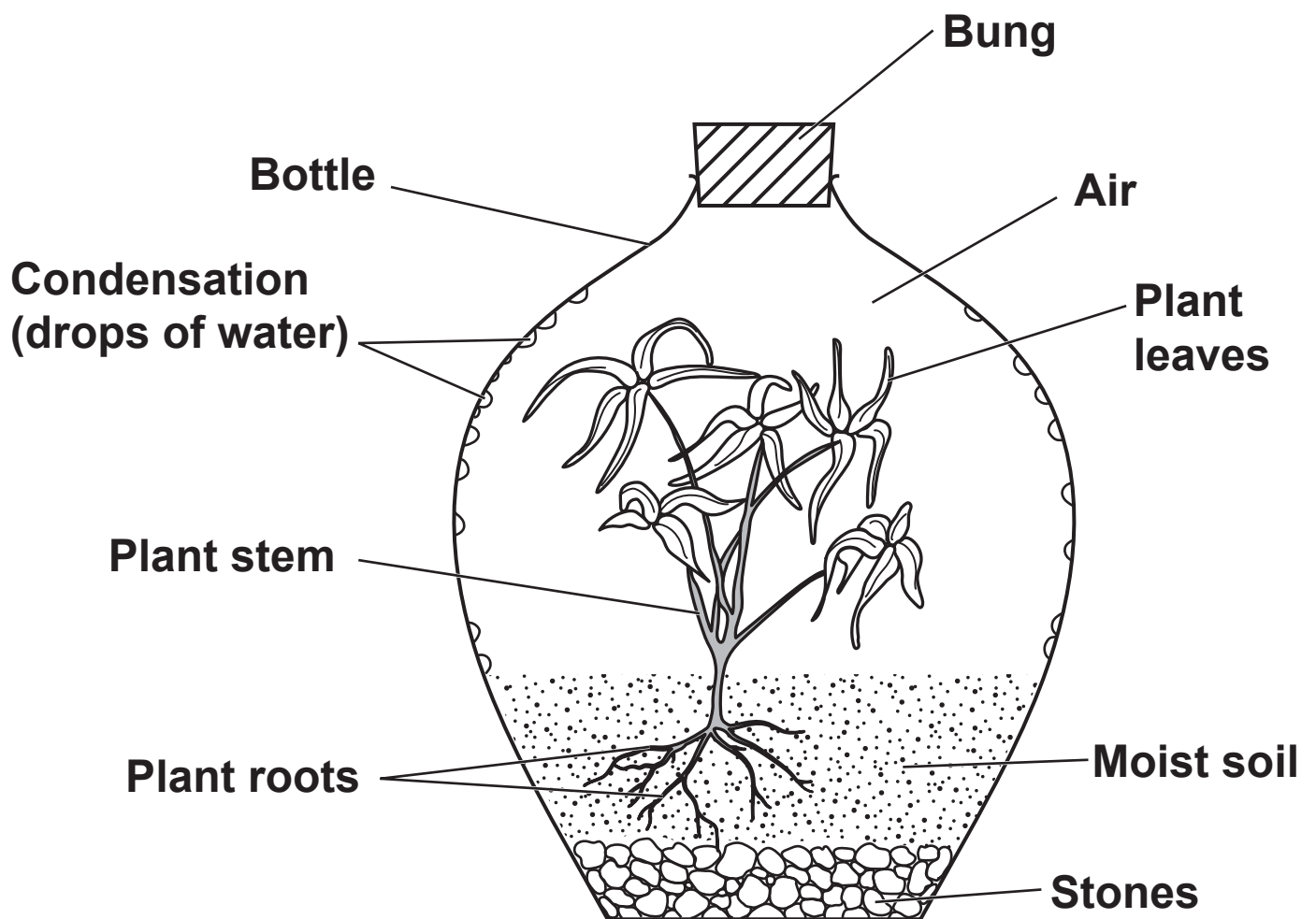
- (e) The student predicts that if a light brightness of 1200 lumens is tested, the pupil diameter will be approximately 2 mm.

Explain why the student is **CORRECT**.

[3]

- 9 The diagram shows a living plant growing in a bottle garden.

The bottle garden is a small but complete ecosystem.



- (a) Which part of the bottle garden ecosystem is BIOTIC?

Tick (✓) ONE box. [1]

Condensation

☐

Plant

☐

Soil water

☐

Stones

☐

(b) Explain why the air in the bottle is an ABIOTIC part of the ecosystem.

[1]

(c) The bottle allows light to pass through it.

Explain why this is essential for the plant to survive.

[1]

(d)* A bung is used to seal the bottle closed.

The plant stays alive even though the bottle is kept sealed for years and no extra water is added.

**Explain:
why the plant needs water
how the plant gets enough water even though the
bottle is kept sealed.**

[6]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

[illegible]

[illegible]



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